

35-10-327

FINDING OF NO SIGNIFICANT IMPACT
Hyperspectral Diagnostic Sensor Development
Sandia Crest, New Mexico

The AF Research Laboratory, Directed Energy Directorate, through their contractor, Kestrel Corporation, seeks to develop, via a Phase II Small Business Innovative Research initiative, an optical sensor capable of temporally and spatially resolving a laser interaction with a target. The passive sensor being developed under this effort only requires the incoming photons from the remote interaction. In order to test the optical sensor system and verify the new technology, Kestrel proposes to create a surrogate target by creating a diffuse light spot located at a distance of about 16 km from the location of the sensor which is positioned in the Kestrel laboratory bay area on 3815 Osuna NE, Albuquerque, NM. The proposed action calls for the placement of a temporary, portable set-up, which creates a 0.5 m diffuse light spot for viewing at a distance. The set-up consists of a relatively small 1 W laser inside an opaque tube, which completely encloses the 5-ft distance of the beam path until it reaches a 1.5 m square sheet of Spectralon™ reflectance material. No further propagation of the laser will occur since the illuminated material is sufficient for passive sensing using the hyperspectral camera located 16 km away. The laser and associated materials are proposed to be located at a lookout point on the Sandia Crest over a 2-3 week period in September or October 2004 with one or two tests days per week occurring in the pre-dawn hours. Two Kestrel engineers will set the hardware up for each test, operate the equipment during the test, and dismantle the hardware and return it to Kestrel after each test session (about 4 hours/session). All activities will be confined to developed, paved roads and walkways. Because of the altitude gain versus horizontal distance obtained between Kestrel's laboratory on 3815 Osuna NE and the Sandia Crest, the Crest area is the preferred site. The attached environmental assessment addresses any possible environmental impact and safety concerns associated with the placement of the setup.

Although a small 1 W laser is needed to form the light spot, the short propagation path and the opaque enclosure ensure a negligible risk to eye safety. The diffuse light created is completely eye and skin-safe. Other considerations include emissions and possible noise levels from a small, portable, 6.5 HP generator. Although, these are not sufficient to significantly impact the local environment and will not harm personnel, wildlife, or threatened and endangered species, continued coordination with the Forest Service will insure minimal disruption. The Forest Service has approved this experiment through a Research Special Use Authorization. The findings of the EA indicate no impact to water resources, biological or cultural resources, and would not create any significant cumulative impacts on these resources. No hazardous materials or wastes will be used or generated during this experiment. Consequently, the temporary placement of the surrogate target system is not expected to have a significant impact on the environment.

The proposal to locate a small surrogate target set-up, which creates a diffuse 0.5 m infrared light spot, would serve to verify the correct functioning of the newly developed demonstrator optical sensor. The sensor itself directly supports mission requirements for

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the Air Force Research Laboratory, Directed Energy Directorate. The temporary set-up will not have a significant effect on the human environment and therefore will not be the subject of an Environmental Impact Statement.

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Environmental Assessment
For
Sensor Development for Passive Diagnosis of Remote
Laser Interaction



Air Force Research Laboratory
Directed Energy Directorate
Kirtland AFB

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TABLE OF CONTENTS

1.0 PURPOSE.....	4
2.0 PROPOSED ACTION.....	4
2.1 PROGRAM OVERVIEW	6
2.2 NEED FOR ACTION	6
2.3 ADDITIONAL ENVIRONMENTAL DOCUMENTATION	6
2.4 ENVIRONMENTAL PERMITS, LICENSES AND ENTITLEMENTS.....	7
3.0 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES.....	7
3.1 DESCRIPTION OF THE TEMPORARY EXPERIMENTAL SETUP.	7
3.2 ALTERNATIVES.....	8
3.3 NO-ACTION ALTERNATIVE	9
3.0 DESCRIPTION OF THE AFFECTED ENVIRONMENTS	9
3.1 INTRODUCTION.....	9
3.2 ENVIRONMENTAL ATTRIBUTES.....	9
3.2.1 <i>Air Quality.</i>	9
3.2.2 <i>Biological Resources.</i>	11
3.2.3 <i>Cultural Resources.</i>	11
3.2.4 <i>Hazardous Materials And Waste.</i>	11
3.2.5 <i>Safety and Occupational Health.</i>	12
3.2.6 <i>Noise.</i>	12
4.0 CONSEQUENCES	13
4.1 AIR QUALITY.....	13
4.2 BIOLOGICAL RESOURCES.....	13
4.3 CULTURAL RESOURCES	14
4.4 HAZARDOUS MATERIALS AND WASTE	14
4.5 OCCUPATIONAL HEALTH AND SAFETY	14
4.6 NOISE	15
4.7 CUMULATIVE IMPACT	16
APPENDIX A	17
APPENDIX B	19

1.0 PURPOSE

A Small Business Innovative Research (SBIR) Phase II effort¹, entitled "High Temporal and Spatial Resolution Laser Beam Diagnostic Sensor" seeks to develop a passive sensor for diagnosing a remote laser/target interaction. A remote passive sensor has the potential for greatly improving the quality of test data that seeks to characterize a laser/target interaction since on-target instrumentation is often difficult to place and of limited capability. The passive sensor being developed under this effort only requires the incoming photons from the remote interaction (it is basically an optical recorder). Since at this stage of the effort there will not be a high-energy laser interaction available for observing, it will be necessary to simulate the optical signature of one by creating a diffuse light spot for testing the proposed detector.

2.0 PROPOSED ACTION

The proposed action calls for the placement of a relatively small 1 W laser inside an opaque tube, which completely encloses the 5-ft distance of the beam path until it reaches a 1.5 m square sheet of Spectralon™ reflectance material. No further propagation of the laser will occur since the illuminated material is sufficient for passive sensing using a hyperspectral camera located in the city. The laser and associated materials are proposed to be located at the lookout point mentioned below over a several week period in September or October 2004 with one or two tests days per week.

Location. The temporary setup for the experiment is proposed to be located on one of the look out points of the West rim of Sandia Crest about 100 m south of the lower parking lot (see Figure 1, 2 and 3). The Sandia Crest is located in the Cibola National Forest at the crest of the Sandia Mountains just East of Albuquerque, New Mexico, within Bernalillo County. These mountains rise over 10,000 feet along the Eastern edge of Albuquerque.

Climate. Climate in the Cibola National Forest varies greatly with elevation. The day to night temperature change is extreme, especially above 7,000 feet. Even in summer, nights are cool to cold depending on elevation. Snow is usually present at timberline until June. Frequent afternoon showers occur in July and August. Winter brings snow, which can be heavy in the higher elevations, and temperatures can dip below zero. Sunny days are common however, even in the winter, with temperatures normally reaching into the 30's and 40's, or higher at the low elevations.

¹ Kestrel Corporation, contract FA941-04-C-5773. The Laser Lethality Branch (AFRL/DELE) manages this effort with Dr. John Otten (former Phillips Lab Commander), Kestrel, as the Principal Investigator.

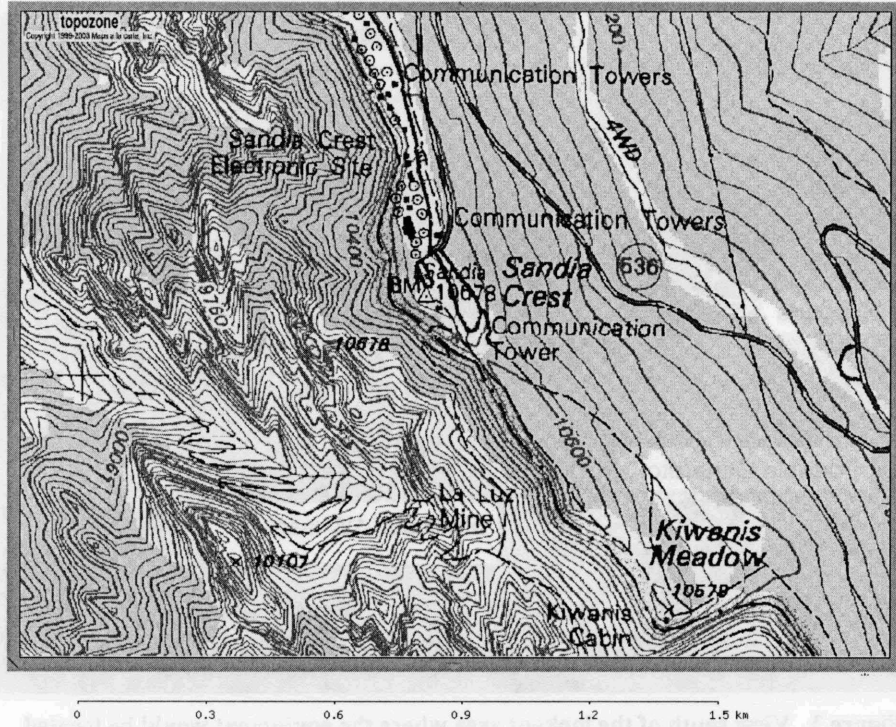


Figure 1 . Location of the Sandia Crest (Peak) area

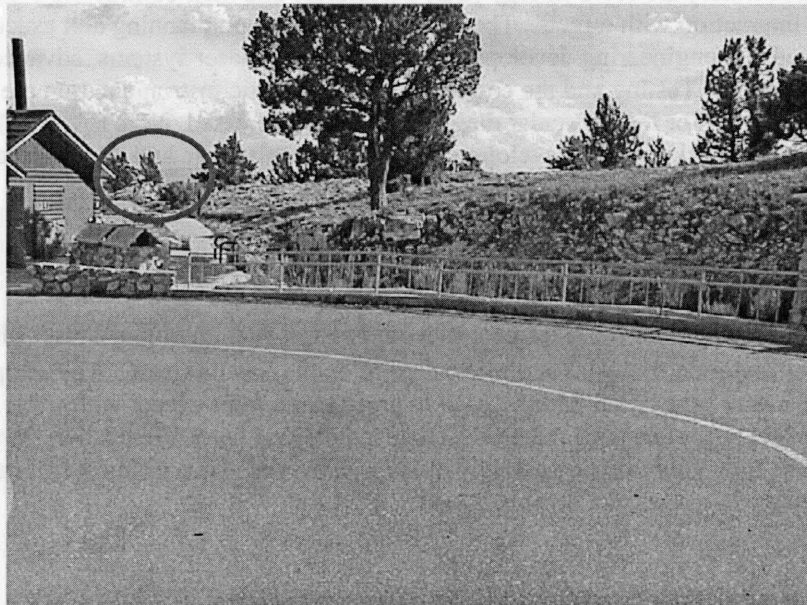


Figure 2. Lower parking lot on the Sandia Crest. The circled area is the lookout where we propose to locate the target. Equipment will be brought up to the parking lot in a pickup truck when ever testing.

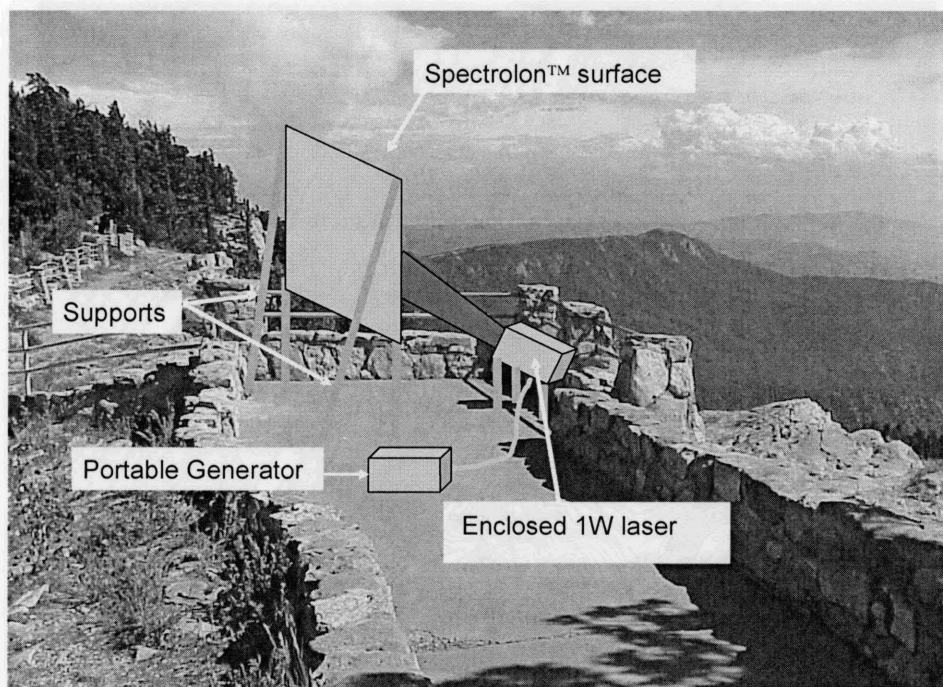


Figure 3. View south of the lookout area where the equipment would be located

2.1 Program Overview

The AF Research Laboratory Directed Energy (DE) Directorate and their contractors conduct research on the effects of laser interaction with targets. The DE charter centers on planning and executing the USAF exploratory advanced and engineering development of high energy laser systems, advanced weapons concepts and technologies. Testing and the corresponding diagnostic instrumentation are a necessary aspect of these objectives. For the particular diagnostic sensor addressed in the EA, live laser/target engagements are not part of the sensor developmental testing at this stage and do not need to be considered.

2.2 Need for Action

The AFRL/DELE needs approval for placement of a temporary setup involving a laser illuminated patch of Spectralon™ reflectance material at a lookout point on the Sandia Crest. The setup simulates the illuminated spot of a laser interaction with no need to propagate a laser except within the 5-foot optically opaque tube onto a sheet of reflectance material. There is no direct laser propagation beyond these confines. The diffuse light spot will be passively monitored over a 16 km distance from an observation point in Albuquerque.

2.3 Additional Environmental Documentation

In the early 1970s the AF prepared several environmental assessments that cover outdoor laser propagation in the Kirtland AFB area for individual programs. Additionally, these documents contain analyses that show outdoor laser propagation has no significant impact on the environment.

2.4 Environmental Permits, Licenses and Entitlements

No environmental permits nor entitlements are required. However, AFRL will obtain approval from the Cibola National Forest Service.

Size of Spectralon - directly proportional to mobility

mobility
position

3.0 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

3.1 Description of the temporary experimental setup.

The proposed action calls for the placement of a relatively small 1W laser inside an opaque tube, which completely encloses the 5-ft distance of the beam path until it reaches a 1.5 m square sheet of Spectralon™ reflectance material. The AFRL SBIR contractor Kestrel will conduct the experiment. No further propagation of the laser will occur since the illuminated material is sufficient for passive sensing using a hyperspectral camera located in the city. The laser and associated materials are proposed to be located at the lookout point mentioned below over a several week period in September or October 2004 with one or two tests days per week.

The particular location on the Sandia Crest offers an ideal line-of-sight for telescopic viewing and camera sensing from the bay area of the Kestrel Corporation Laboratory located at 3815 Osuna Rd NW. The total path length to the mountain top is about 16 km, depending on where the target is located. These path lengths agree well with what is expected in the use of the camera, 16 km to 20 km. This provides the required signature to close a fine track loop. A circular 0.5 m diameter spot will be created on the Spectralon™ material with a 1.31 μm laser that is located on Sandia Crest a few feet from the surface. The laser located on Sandia Crest, next to the Spectralon™, will then be turned on and the camera will record the observed image. By varying the intensity and the size of the spot on the Spectralon™ sheet, data to calculate camera performance limits can be obtained. The entire setup is depicted in Figure 4.

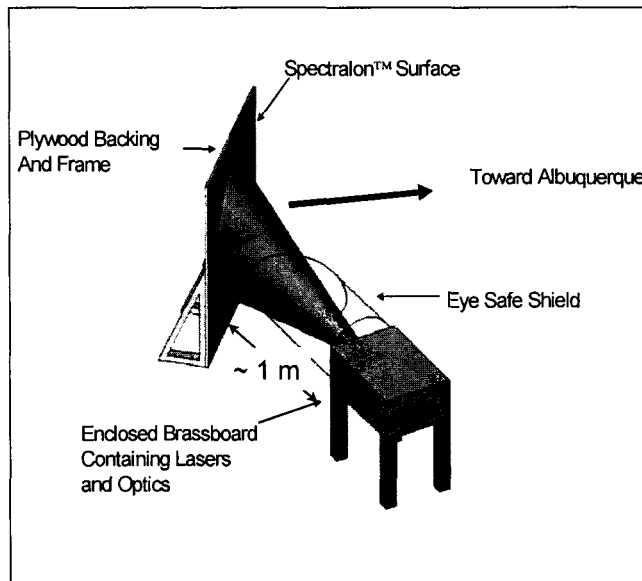


Figure 4. Schematic of the configuration. Note that the laser beam will be protected from direct viewing with a cover

Experiment Configuration

The Spectralon™ sheet will be illuminated using a 1 W, 1.31 μm laser that has been expanded to 0.5 m on the sheet. This laser is physically quite small, about 30 cm by 30 cm by 20 cm and will be located a few feet from the sheet of Spectralon™. A small optical brassboard, less than 1 m by 0.4 m, will be used to mount the laser and a set of optical lens that can be used to vary the size of the beam on the Spectralon™. Filters will be inserted to vary the level of the laser illumination on the Spectralon™. Because the laser beam as it leaves the laser housing is not eye safe, a protective cover will be installed over the brassboard and all operators will use safety eyewear, Figure 3. As for bystanders, the experimental setup is to be carried out during pre-dawn hours when public presence is minimal. Experimental setup will be suspended if any person not associated with the experiment is in the vicinity. Once the laser has been expanded on the brassboard it will be eye safe and can be safely propagated the short distance, about 1 m., to the Spectralon™. For alignment purposes, a small eye safe, 5 mW class, visible laser will be co-aligned with the 1.31 μm beam. Because of the location on the edge of the Sandia Crest, direct observation of either the 1.31 μm or the visible alignment beam will not be possible by anyone other than the Kestrel engineer(s) aligning the equipment. Flux in the line of sight from the laser light reflected from the diffuse target toward Albuquerque will be eye safe since it will be substantially below (by a factor of 9²) the eye safety levels of 462 J/m² for a 10 sec exposure³. Electrical power for the lasers will be provided by a small portable power supply (generator) that has a spark suppressant exhaust. The proposed experimental set up uses all commercially available hardware that is UL or ISO 2001 approved and has no harmful RF emissions.

The experiment will be operated at night, with data most likely being collected during the pre dawn temperature inflection period. For each observation, the Spectralon™ and lasers equipment will be assembled at the lookout point on Sandia Crest and then completely removed at the completion of the test period. Experiments will only be conducted during clear, stable, low wind (< 5 mph), meteorological conditions normally during non daylight hours. Communications between the sensor location in the city and the test site will be by use of standard cell phones. Two Kestrel engineers will set the hardware up for each test, operate the equipment during the test, and dismantle the hardware and return it to Kestrel after each test session (about 4 hours/session). We anticipate needing to collect data over a 2-3 week period in September or October 2004 with one or two tests days per week. The test equipment would be dismantled and removed every day to insure minimal conflict with any early morning tourists.

2.2 Alternatives

The alternative is to relocate the experiment on Kirtland AFB. This however would not provide the same altitude gain versus horizontal distance as the Sandia Crest Area. If the experiment dispensed with the altitude advantage and relocated to an area on Kirtland AFB, this would require the relocation of a 5500 lb highly sensitive telescope and associated hyperspectral camera and optical instrumentation from their laboratory facilities. Spatial precision is critical to this experiment making such a move impractical.

² The laser power is 1W, spread into a circle of 0.5m diameter on the spectralon, therefore power density on the spectralon = $1/(\pi \cdot 0.25^2) = 5.093 \text{ W / m}^2$. For a 10 second exposure, the energy density is $5.093 \cdot 10 = 50 \text{ J / m}^2$. So, the energy density at the target is within the safety limits. The reflection off the spectralon will only serve to reduce this further, as it spreads the energy into a hemisphere.

³ "Guidelines on Limits of Exposure to Laser Radiation of Wavelengths Between 180 nm and 1000 nm", International Commission on Non-Ionizing Radiation Protection, 1996, Health Physics Society

2.3 No-Action Alternative

If the no-action alternative was selected, the production of the high-resolution hyperspectral imaging device could be completed, but the final product would not be realistically tested and the specified operating regimes would not be adequately verified. The likelihood of success for this innovative technology would be reduced with a potential detrimental consequence to the investment in this type of research.

3.0 DESCRIPTION OF THE AFFECTED ENVIRONMENTS

3.1 Introduction

This chapter will describe environmental baselines from which any environmental changes brought about by the proposed action and alternatives can be identified and evaluated. The 6 environmental attributes used in this environmental assessment were selected because they have a potential to be affected by the proposed activities. These attributes provide a baseline for understanding the potential effects of the proposed action and a basis for assessing the significance of the potential impacts in the NEPA process. The attributes that have the potential for significant impacts have been described in greater detail.

Federal and/or State environmental statutes regulate several of the attributes. The standards defined in the statutes provide a benchmark to assist in the determination of environmental impacts significance. The compliance status of each attribute with respect to the applicable statute was included in the information collected on the affected environmental attribute.

Information on the existing condition of each of the attributes was collected from available literature. To fill in data gaps, and to update and verify existing data, installation personnel and Federal, state, and local regulatory agencies were contacted.

This chapter is organized into two primary sections: general description of the method and approach for each environmental attribute; and description of the existing condition of these attributes.

3.2 Environmental Attributes

3.2.1 Air Quality.

This refers to the quality of air impacting the human environment. Only the emissions in a portion of the total volume of the atmosphere are typically considered when performing an air quality analysis. The quality of air below 3,000 feet above ground level (AGL) is the region of most concern to the human environment. EPA generally uses 3,000 feet AGL as the default-mixing height (or depth) across the United States. The mixing height is defined as the height above the surface through which relatively vigorous vertical mixing occurs. The value of this height is set primarily by the atmosphere's local vertical temperature profile. A boundary layer exists at the mixing height that inhibits the rapid vertical transfer of air. Pollutants emitted above the mixing height become diluted in the very large volume of air in the troposphere before they are slowly transported down to ground level. These emissions have little or no effect on ambient air quality. Therefore, the air quality issues for this proposed experiment are not relevant since the proposed setup only includes a small generator operating for a few hours at an altitude of 5,000 ft (AGL)

1. then
using
50,000 ft

Air quality in a given location is measured by the concentrations of various pollutants. The significance of a pollutant concentration is determined by comparison with federal, state, and local ambient air quality standards. These standards establish limits on the maximum allowable concentrations of various pollutants to protect public health and welfare.

The New Mexico Administrative Code, Title 20, Part 11.04, (20 NMAC 11.04), entitled "General Conformity" implements section 176(c) of the Clean Air Act, as amended (42 U.S.C 7401 et seq), and regulations under 40 CFR 51, subpart W, with respect to conformity of general federal actions in Bernalillo County. Part 11.04.II.1.2, paragraph B, establishes the emission threshold of 100 tons per year for carbon dioxide (CO). Bernalillo County is designed as a maintenance area for CO.

The EPA, through the Clean Air Act (CAA), regulates and sets standards for pollutant levels in the air. Primary National Ambient Air Quality Standards (NAAQS) are established for the sole purpose of protecting public health. States are required to establish an Implementation Plan designed to eliminate or reduce emissions exceeding the NAAQS and to ensure that air quality conditions consistently comply with the NAAQS. The CAA prohibits federal agencies from supporting any activities that do not conform to a State Implementation Plan approved by the EPA. Regulations under the CAA, known as the General Conformity Rule, state that activities must not:

- Cause or contribute to any new violation of any standard;
- Increase the frequency or severity of an existing violation; or
- Delay timely attainment of any standards, interim emission reductions, or milestones as stated in the State Implementation Plan.

This General Conformity Rule applies only to those areas in non-attainment with the NAAQS. The applicability criteria for the General Conformity Rule are based on net increases in emissions over the significance thresholds for criteria pollutants and their precursors (Table 3-1). In addition, even if net increases in emissions are less than the significance thresholds, a pollutant could still be considered "regionally significant" under the General Conformity Rule if emissions of that pollutant resulting from the proposed actions represent more than 10 percent of the total emissions of that pollutant in the air quality region.

Currently, the city of Albuquerque controls carbon monoxide (CO) emissions through automotive inspection and maintenance programs, oxygenated fuel requirements, and transportation control measures. The Albuquerque Environmental Health Department, Air Pollution Control Division, also implements a program during the winter months restricting the use of wood-burning fireplaces and stoves during inversion conditions.

Table 3-1. Criteria Pollutant Thresholds

Pollutant	Threshold (tons/year)
CO	100
NOX	100
VOC	100
SO ₂	100
PM ₁₀	100
Pb	25

Note: The threshold level for CO pertains to the General Conformity Rule and NEPA. The thresholds listed for the other criteria pollutants pertain to NEPA only. See discussion for NEPA Level of Significance; "regionally significant" under the General Conformity Rule if emissions of that pollutant resulting from the proposed actions represent more than 10 percent of the total emissions of that pollutant in the air quality region.

Fugitive dust is also a contributor to air pollution within the region due to New Mexico's dry climate. Windblown dust from local fields, streets, roads, and construction zones contributes particulate matter to the local air shed.

Significance Threshold. The CAA conformity rule states that only net increases in emissions must be considered. Although a conformity determination pertains only to non-attainment or maintenance pollutants, National Environmental Policy Act (NEPA) requires that the air quality significance of attainment pollutants be considered as well. The Albuquerque-Bernalillo County Air Basin is in attainment for PM₁₀, SO₂, NO_x, and VOC. The conformity analysis significance levels for these

what are current levels, particularly CO?

pollutants are also appropriate for determining significance of air quality impacts under NEPA. The significance level for all of these attainment pollutants in this air basin is 100 tons per year (tpy).

3.2.2 Biological Resources.

Biological resources are defined as the native and naturalized flora and fauna in terrestrial and aquatic ecosystems. Threatened and endangered species, migratory birds, eagles, marine mammals, and wetlands are of special importance because they receive specific protection under federal and state laws. The *Endangered Species Act* (16 USC ' 1531) is intended to protect and restore endangered and threatened species of animals and plants and their habitats. The New Mexico Department of Game and Fish protects endangered and threatened wildlife species under the authority of the *New Mexico Wildlife Conservation Act* (19 NMAC ' 33.1). The New Mexico Energy, Minerals and Natural Resources Department protect endangered and threatened plant species under regulations governing endangered plant species (19 NMAC ' 21.2).

Describe veg, wildlife, wetlands on site - Are there any federal or state protected resources? Explain why.
Vegetation and wildlife of any kind surrounding the proposed experimental setup will not be impacted.

3.2.3 Cultural Resources.

The heritage of the United States is reflected in the sites, structures, districts, and objects that contribute to an understanding of American history and culture. A number of federal and state regulations protect cultural resources. The *National Historic Preservation Act* (NHPA) (16 USC ' 470) is the key federal statute regulating the identification and protection of cultural resources. The NHPA established the National Register of Historic Places (NRHP), the responsibilities of the State Historic Preservation Office, and the Section 106 review and compliance process. The *New Mexico Prehistoric and Historic Sites Act* (18 NMSA ' 8.7, 1978) requires consultation with the State Historic Preservation Officer. Section 106 is a procedural requirement whereby federal agencies must consider the effects of potential actions on cultural resources that are eligible for listing on the NRHP.

Indicated
There are no cultural resources within 3 miles of the Sandia Crest⁴.

3.2.4 Hazardous Materials And Waste.

The term *hazardous materials* is derived from the U.S. Department of Transportation (DOT) and EPA lists of chemicals that require packaging or that trigger notification if spilled (49 USC ' 1801). A hazardous material is any material whose physical, chemical, or biological characteristics, quantity, or concentration may cause or contribute to adverse effects in organisms or their offspring, pose a substantial present or future danger to the environment, or result in damage to or loss of equipment, property or personnel.

RCRA contains standards to determine if a waste is hazardous as a result of being on one of four published lists or because it exhibits at least one of the following characteristics: ignitability, corrosivity, reactivity, or toxicity. RCRA and the resulting regulations require a detailed life-cycle program to track and control hazardous waste with specific standards and procedures for the handling, storage, treatment, and disposal of hazardous waste.

Title III of the *Superfund Amendments and Reauthorization Act* (SARA) (Public Law 99-499) is the *Emergency Planning Community Right to Know Act* (EPCRA). EPCRA requires that facilities that use or store certain hazardous materials above specified quantities must report usage to various government agencies for public access. EPCRA also requires facilities to report hazardous material releases exceeding specified quantities.

4 National register of historic places, database at <http://www.nr.nps.gov/>

On the state level, the New Mexico Environment Department regulates hazardous waste operations under the *New Mexico Hazardous Waste Act* (74 NMSA ' ' 4.1-4.14), and the *New Mexico Hazardous Waste Regulations* (20 NMAC ' 4.1).

3.2.5 Safety and Occupational Health.

Health and safety is defined as the protection of workers and the public from hazards. The total accident spectrum encompasses not only injury to personnel but also damage or destruction of property or products.

The governing regulations regarding outdoor laser operations are ANSI Standard Z136.1-2000, AFOSH Standard 161-10, and Kirtland AFB Instruction 48-109. Additionally, AFRL tests and experiments must go through the AFRL test safety review process (AFI 91-202/AFMC Sup 1 and AFRLI 91-101) prior to start of an experiment.

The principal federal statute regulating the safety of workers and the public is the *Occupational Safety and Health Act* (OSHA) (29 USC ' 651). The Air Force provides additional guidance to protect personnel from occupational deaths, injuries, or illnesses through the AFI 91-301, *Air Force Occupational and Environmental Safety, Fire Prevention, and Health (AFOSH) Program* many other Air Force instructions and standards.

3.2.6 Noise.

Federal agencies operating airfields are required to work with local, regional, state and other federal officials on compatible land use planning (OMB FMC 75-2). The USAF developed the Air Installation Compatible Use Zone Program (AICUZ) to implement the requirements of OMB FMC 75-2. One of the requirements of the AICUZ program is to analyze the affect of noise from airfield operations on the surrounding community. Land areas exposed to aircraft operations that ^{may} affect public health, safety, or welfare are defined as being within the 65 dB CNEL noise contour (AFI 32-7063).

AICUZ noise studies develop noise contours by using aircraft operational and maintenance data. The contours plotted are for 65, 70, 75, and 80-plus dBs CNEL for AICUZ maps. These plots represent an average of the noise generated by all airfield operations and maintenance activities over an entire year. The AICUZ maps can be used as a baseline for background noise levels. [Note, since AICUZ studies are for airfield noises, they are not applicable to missile launches at test ranges.] *irrelevant*

The *Federal Noise Control Act* (42 USC ' 4901) provides the basis for the EPA to encourage the development of state and local noise control programs, and directs federal agencies to comply with local community noise statutes. The Act also directs federal agencies to carry out programs in a manner that minimizes noise impacts on public health and welfare.

What are the noise levels at the Crest?

4.0 Consequences

The proposed experimental setup and operation would occur on the look-out point of the Sandia Crest. This section analyzes the potential impacts to environmental and human resources resulting from the temporary experiment and setup.

Although a small laser is part of this setup, it does not propagate in the atmosphere since the entire beam bath is enclosed with an opaque covering and the beam target, 5 ft down the beam path, is a 1.5 m square patch of reflectance material. No further propagation will occur and the reflectance material will remain well below pyrolyzation temperatures at all times.

4.1 Air Quality.

Current impacts to air quality at Kirtland AFB result primarily from aircraft and automobile emissions, and evaporative losses from fueling those vehicles. The city of Albuquerque has been designated as being in maintenance status for carbon monoxide (CO) as of 15 June 1996, and is currently in attainment for all other federally regulated pollutants. As a result, CO emission levels are the most closely monitored (INRMP, 2001).

Generator and Vehicle Emissions. The enclosed laser propagation would not impact air quality. No gaseous chemicals are used nor needed for small power solid-state lasers. Air emissions would originate only from the small generator and the vehicles used to drive to the Crest area. Both are temporary over a 2-3 week period in September or October 2004 with one or two tests days per week (about 4 hours/session). This would require, at most, 2 vehicles/trip for a total of 6 trips. Using estimated carbon monoxide (CO) emissions for one vehicle traveling 30 miles per day for 12 days (360 miles x 25 grams CO/mile⁵ = 9000 grams CO = 19.84 pounds. Based on this calculation, the air emissions from vehicles are de minimis. The regulation for CO states that the threshold is 100 tons/year. Additional CO output from the generator would not be significant relative to the 100 tons/year criteria (Table 3-1).

No-Action Alternative

The No-Action Alternative represents a cancellation of the experiment.

Conclusions

The net emissions increases associated with the proposed actions are below the significance thresholds and are not regionally significant, the air quality impacts would be deemed less than significant with respect to NEPA; and a conformity determination for purposes of CAA, 42 US Code Section 7401 et seq., would not be required. The estimated emissions for all criteria pollutants were found to be below the de minimis threshold levels and less than 10 percent of the Albuquerque-Bernalillo County air basin's total emissions inventory; therefore, the EPA's General Conformity Rule is not applicable to the proposed actions or any of the alternatives. Neither the proposed action nor the alternative would cause or contribute to the violation of an air quality standard nor interfere with the attainment of any standard.

4.2 Biological Resources.

Threatened and Endangered Species. The proposed experimental setup, including transport, will be carried out on paved, publicly accessible areas. No biological resources will be impacted. No animal species, including federally endangered species, will be affected by this experiment. NO impacts to flora and fauna are expected. There is no requirement for construction of facilities that might impact a sensitive habitat. All activities would be coordinated with the National Forest Service to ensure impacts to any biological resources would remain negligible.

⁵ <http://www.epa.gov/rtp/transportation/carpooling/emissions.htm>

No-Action Alternative

Under the No-Action Alternative, The condition of biological resources within the Sandia Crest lookout point would remain unchanged.

Conclusions

There is no biological impact to the environment. The proposed activities would take place in existing publicly accessible, paved surfaces with existing public roads. Thus, there is very minimal potential for harm to natural vegetation, wetlands, wildlife, and threatened and endangered species.

4.3 Cultural Resources

The proposed temporary experiment would not impact any cultural resources. The contained laser setup will be situated in a developed area. All activities would be ~~coordinated~~ ^{approved by} with the National Forest Service.

No-Action Alternative

Under the No-Action Alternative, there would be no change to the environment from its current state, and therefore no potential impact to cultural resources.

Conclusions

Impacts to cultural resources from the proposed activity would be negligible. All activities would take place at existing facilities.

4.4 Hazardous Materials and Waste

No hazardous materials or waste will be used or generated during the proposed experiment. All activities would be coordinated with the National Forest Service. All materials to be used meet the appropriate safety criteria.

No-Action Alternative

The No-Action Alternative would result in no changes to the existing environment.

Conclusions

There would be no use of hazardous materials.

4.5 Occupational Health and Safety

Laser Safety. The AFRL Directed Energy Directorate uses an aggressive system safety program that evaluates each experiment and determines the activities that must be performed to minimize or eliminate hazards. All experiments have safe operating procedures, test hazard analyses/operational risk assessments, and system safety permits in accordance with AFI 91-202 AFMC Sup 1 and AFRLI 91-101. The proposed laser to be used would be subjected to these safety criteria including ANSI 2.136.6-2000, "American National Standard for Safe Use of Lasers Outdoors."

The Spectralon™ sheet will be illuminated using a 1 W, 1.31 μm laser that has been expanded to 0.5 m on the sheet. This laser is physically quite small, about 30 cm by 30 cm by 20 cm and will be located a few feet from the sheet of Spectralon™. A small optical brassboard, less than 1 m by 0.4 m, will be used to mount the laser and a set of optical lens that can be used to vary the size of the beam on the Spectralon™. Filters will be inserted to vary the level of the laser illumination on the Spectralon™.

Because the laser beam as it leaves the laser housing is not eye safe, a protective cover will be installed over the brassboard and all operators will use safety eyewear, Figure 3. As for bystanders, the experimental setup is to be carried out during pre-dawn hours when public presence is minimal.

Experimental setup will be suspended if any person not associated with the experiment is in the vicinity. Once the laser has been expanded on the brassboard it will be eye safe and can be safely propagated the short distance, about 1 m., to the Spectralon™. For alignment purposes, a small eye safe, 5 mW class, visible laser will be co-aligned with the 1.31 μm beam. Because of the location on the edge of the Sandia Crest, direct observation of either the 1.31 μm or the visible alignment beam will not be possible by anyone other than the Kestrel engineer(s) aligning the equipment. Flux in the line of sight from the laser light reflected from the diffuse target toward Albuquerque will be eye safe since it will be substantially below (by a factor of 9^6) the eye safety levels of 462 J/m^2 for a 10 sec exposure⁷. Electrical power for the lasers will be provided by a small portable power supply (generator) that has a spark suppressant exhaust. The proposed experimental set up uses all commercially available hardware that is UL or ISO 2001 approved and has no harmful RF emissions.

The 1 W laser has been certified by the 377th Medical Group at Kirtland AFB (Appendix B).

No-Action Alternative

Under the No-Action Alternative, there would be no change to the environment from its current state under the use of Kirtland AFB, and therefore no potential impacts to safety would occur.

Conclusions

All activities would take place in accordance with the Air Force, AFOSH ANSI program and all other pertinent safety regulations. There is no anticipated significant safety impact because the experimental setup would be consistent with and in full compliance with all established safety and health regulations. In addition, there are no public health or safety issues for the proposed action that might be incompatible with similar safety concerns for adjacent or nearby facilities.

4.6 Noise

Noise generation would occur only with the operation of a small generator. No unusual levels requiring hearing protection are expected and the placement of the generator is temporary.

noise level? affects because of time of day

No-Action Alternative

Under the No-Action Alternative, there would be no change to the environment from its current state, and therefore no potential impact to land use.

Conclusions

Noise levels from the operation of a small generator would be far below any safety threshold.

annoyance?

⁶ The laser power is 1W, spread into a circle of 0.5m diameter on the spectralon, therefore power density on the spectralon = $1/(\pi \cdot 0.25^2) = 5.093 \text{ W/m}^2$. For a 10 second exposure, the energy density is $5.093 \cdot 10 = 50.93 \text{ J/m}^2$. So, the energy density at the target is within the safety limits. The reflection off the spectralon will only serve to reduce this further, as it spreads the energy into a hemisphere.

⁷ "Guidelines on Limits of Exposure to Laser Radiation of Wavelengths Between 180 nm and 1000 nm", International Commission on Non-Ionizing Radiation Protection, 1996, Health Physics Society

4.7 Cumulative Impact

The addition of performing temporary sensor experiments at Sandia Crest would create a slight increase of vehicle and foot traffic on the Crest. Vehicle and foot traffic would stay on previously established roads and disturbed areas. This incremental impact of performing the proposed experiment is negligible and does not create a significant cumulative impact.

Appendix A
Letter from the Forest Service



United States
Department
of Agriculture

Forest
Service

Cibola
National
Forest

0131
Sandia Ranger District
11776 Highway 337
Tijeras, NM 87059
(505)281-3304
FAX: (505)281-1176

File Code: 2720

Date: August 25, 2003

Elinor I. Reiners, Vice-President
Kestrel Corporation
3815 Osuna NE
Albuquerque, NM 87109-4430

Dear Ms. Reiners:

This letter responds to your August 11, 2003 letter in which you identified a potential request for conducting tests from a location near Sandia Crest. I understand that these tests are likely to occur next summer and your Corporation will contact this office with details approximately two months in advance.

Based on the information currently available, I anticipate authorizing your proposed activities under a Research Special Use Authorization. Actual authorization is contingent upon review of your final proposal and conditions, e.g., fire severity, at the time. Please contact Susan Johnson at this office with further details as previously identified.

Sincerely,


CLIFFORD J. DILS
District Ranger

Contract/Proposal #: 0131
cc: File

A. Jones

Initial/Date: 9/9/03 k

Appendix B
Kirtland AFB Laser Certification



DEPARTMENT OF THE AIR FORCE

377th Medical Group (AFMC)
2060A Second Street SE
Kirtland AFB NM 87117-5522

Laser

2 June 2004

MEMORANDUM FOR AFRL/DELE (Casefile 207A)

Attn: Mr. David Medina

FROM: 377 AMDS/SGPB
2050 A SECOND STREET SE
KIRTLAND AFB NM 87117-5559

SUBJECT: Laser Certification for Laser Test Effects Facility

1. We have evaluated the nominal ocular hazard distance (NOHD) and optical density (OD) requirements for the following laser to be used in AFRL/DELE.
2. Please refer to the laser hazard evaluation (Atch 1) for details and an explanation of the hazard distance and OD requirements. Our evaluation was based on the maximum permissible exposure (MPE) limits of the American National Standard for Safe Use of Lasers (ANSI Z136.1). Exposure to lasers is regulated under Air Force Occupational Safety and Health (AFOSH) Standard 48-139, *Laser Radiation Protection Program*.

Laser Certification has been issued for the following laser:

<u>Cert No</u>	<u>Manufacturer</u>	<u>Serial No.</u>	<u>Medium</u>	<u>Operating Wavelength</u>	<u>OD</u>	<u>ANSI Class</u>	<u>NOHD (m)</u>
2004-29	Crystal Lasers	23311034-1487	NdYLF	1.31 μ m	1.81	4	18.7

3. Organizations that conduct outdoor firing of lasers must receive Controlled Firing Area Committee (CFAC) approval before outdoor laser operations. The CFAC meets on the 3rd Thursday of each month at 1300. Contact Mr. Perry Mitchell, 377 ABW/SEW at 846-9142 for more information.
4. The attached laser hazard evaluation outlines the parameters used for calculations. Ensure the attached certification tag included in Attachment 2 is affixed to each laser. Include the safety information provided in these certifications in your specific laser safety operating instructions and update us on any changes to laser parameters. This certification supersedes any previous laser hazard evaluations and/or certifications, based on a change in operating parameters.

APPENDIX B


Sent By: 377 AMDS/SGPB;

5058464196;

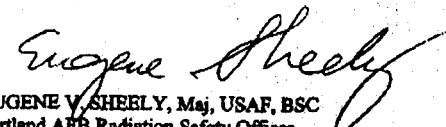
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Page 2/5

5. AFOSII Std 48-139 and KAFBI 48-109, *Laser Hazard Control Program*, require personnel whose duties involve the use of ANSI class 3b and 4 lasers to receive an eye examination prior to and upon termination of assignment to laser related duties. Contact Public Health Flight, ext 6-3420 if you have any questions regarding laser eye examinations.


DAVID J. WELLS, Sr., USAF
Bioenvironmental Engineering Flight

Reviewed by:


EUGENE V. SHEERLY, Maj, USAF, BSC
Kirtland AFB Radiation Safety Officer

Attachments:

1. Laser Hazard Evaluation
2. Laser Certification Tag

cc:

AFRL/DEOS w/o Atch 1 and 2
377 ABW/SE w/o Atch 1 and 2
377 AMDS/SGPM w/o Atch 1 and 2

APPENDIX B

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Page 3/5

Laser Evaluation Report LHAZ Version 4.2.4 Wednesday, June 02, 2004

Laser Name: 2004-29

A. A hazard evaluation was accomplished for a laser with the following operational characteristics:

Laser Parameters:
Wavelength: 1.31 μ m
Output Mode: C.W.
Average Power: 1 W
Beam Profile: circular
Beam Distribution: gaussian
Beam Divergence: 0.003 X 0.003 rad
Beam Waist Diameter: 0.045 X 0.045 cm
Beam Waist Range: 0 X 0 m
Output Aperture Diam: 0.5 X 0.5 cm
Source Size: 0 X 0 cm

Viewing Conditions:
Atm. Attenuation Coef: 1.3e-007 (1/cm)
Aided Viewing Used: False
Optics Transmittance: 0.7
Optics Objective Diam: 6.00 cm
Optics Exit Diam: 0.70 cm

B. This is an ANSI Z136.1-2000 Class 4 Laser and should be operated in accordance with the safety measures outlined in the AFOSH STD 46-139 along with such other safety procedures required by the responsible laser safety officer.

Classification Analysis:
Unaided Viewing: ~~Class 2~~
Aided Viewing: ~~Class 2~~

C. The Maximum Permissible Exposure (MPE) limits are listed below. The MPE is defined as the radiant which personnel may receive without biological effects. MPE values were computed at a range of 10 cm.

MPE Computations:
Exposure Duration: 10 seconds
Exposure Range: 10 cm
~~MPE (Skin): 1.000e-002 W/cm2~~
Limiting Aperture(Eye): 0.7 cm
Class 1 AEL(Eye): 1.539e-002 W
Limiting Aperture(Skin): 0.35 cm
~~MPE (Skin): 1.000e-002 W/cm2~~

D. The Nominal Ocular Hazard Distance (NOHD) values for various exposure conditions are listed below. Also listed are the Nominal Skin Hazard Distance (NSHD) values. These intra-beam viewing hazard distances are defined as the distances from an operating laser at which the

APPENDIX B

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Page 4/5

radiant exposure is equal to the MPE for the eye or skin. Include are the OD requirements. The optical density (OD) is a measure of the opacity to radiation expressed in logarithmic units.

Hazard Distances and OD Requirements:

Ocular

Exposure Duration: 10 seconds
~~NEZ (Eye)~~
At Viewing Distance: 10 cm
~~At Range OD:~~
At Range OD: 1.81

Skin

Exposure Duration: 600 seconds
~~NEZ (Skin)~~
At Exposure Distance: 10 cm
~~At Range OD:~~
At Range OD: 1.02

Diffuse Reflection Hazard Analysis:

Laser to Target Range: 100 cm
Target Reflectance: 1
Viewing Angle: 0.00 degrees

Ocular Hazards

Exposure Duration: 600 seconds
~~NEZ:~~
At Viewing Distance: 100 cm
~~OD Required:~~
OD Required: 0

Skin

Exposure Duration: 600 seconds
~~NEZ (Skin)~~
At Exposure Distance: 100 cm
~~OD Required:~~
OD Required: 0.00

APPENDIX B

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Page 5/5

KAFB Laser Certification # 2004-29

Unit AFRL/DELE

Bldg # Sandia Crest

Rm/Lab # 0

MPGR Name Crystal Lasers

Laser Model IRCL-1313-P

Laser SN 2311 034-1487

Wavelength (nm) 1.31

Optical Density Required 1.81

NOHD (m) 18.7 @ 10 sec

ANSI Class 4

Date 5/21/2004

Approving Official